COHERENT COMBINER AND SHAPER USING FAST AND SLOW AXES

Background of the Invention

1. Field of the Invention

The present invention relates to a method, apparatus, and system for the shaping and forming of laser beams. More particularly it relates to the shaping and forming of laser beams from laser diodes.

2. Background Information

Since the advent of lasers, the usefulness of lasers often depends on th shape of the laser's profile. Various combinations of lenses and other optical devices have been used to shape and manipulate the laser profiles to obtain useful profile characteristics.

One area of interest is the beam combining and shaping of laser profiles from laser diodes. The advantage to using laser diodes is that they are small, provide lightweight optics, can be used in military and harsh environments and have long storage lives. In addition laser diodes provide low cost reliable configurations if the profiles of the emitted laser beams can be shaped and/or combined to desired specifications.

One problem currently plaguing the shaping of laser beam profiles, in particular the shaping of laser diodes or laser diode bars, is shaping the profiles

into point sources and imaging a single dimension diode bar laser profile into a two dimensional laser profile.

Summary of the Invention

It is therefore an object of the present invention to provide an optical system for beam shaping and/or combining laser beam(s) into a desired profile in a predetermined far field region.

The object of the present invention may be realized by providing a fast and/or slow axis lens or lenses to utilize the various fast and slow wave index of refractions to reshape an incident laser beam profile into a desired laser beam profile.

Additionally the object of the present invention may be realized by providing a fast and/or slow axis lens or lenses to utilize the various fast and slow wave index of refractions of the lenses to reshape an incident laser beam profile(s) into a desired laser beam profile(s). The lenses can be lens elements on at least one lens array and the laser beams being combined can originate from multiple laser sources.

Additionally if the lenses are elements of lens arrays then two or more lens arrays can be positioned so that their phases interact to vary the profile shapes temporally and spatially at a desired location.

Additionally the lenses can be configured to transform a one dimensional laser beam(s) profile into a two-dimensional or various other one-dimensional profiles.

The advantages of the optical devices formed in accordance with the present invention and the methods derived thereof is effectively reduce the source size so that one can achieve greater collimation and energy density.

Brief Description of the Drawings

The present invention will become more fully understood from the detailed description given herein below and the accompanying drawings, which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

Fig. 1 shows a single laser diode where the far field profile of the single diode laser beam is shaped by fast axis and slow axis lenses;

Fig. 2 shows a laser diode bar array, where the far field profile of the bar diode laser beam is shaped by fast axis and slow axis lenses;

Fig. 3 shows a laser diode bar array using multiple lens arrays that phase interact to vary the far field profile of an incident beam(s) to a desired shape; and

Fig. 4 shows the transformation of Initial 1-D profile from a bar diode laser to a different dimension or spread into a two-dimensional profile.

Detailed Description:

Figure 1 illustrates an exemplary embodiment of the present invention. A multimode laser diode 10 or multimode laser diode bar (Figure 2) emits light which passes through a lens with variable fast and slow indices of refraction or variable slow and fast properties, fast/slow axis lens or lenslet array 20. the light passing through the fast/slow axis lens or lenslet array 20 has its slow and fast properties affected such that the cross sectional profile is changed. For example Figure 4 shows an exemplary embodiment of the present invention where a linear original profile 105 is rotated to form a transformed profile 150 by varying the slow and fast properties of the lenses 110, 120, 125 through which the light passes.

Light passing through the fast/slow axis lens or lenslet array 20 will have it's profile varied. The varied profile is changed further by passing the light leaving the fast/slow axis lens 20 through a fast/slow axis lens or lenslet array 30 resuling in a condensed farfield profile. The lenslet arrays can be birefringent crystals, periodic transparent structures resulting in diffraction or lenslet arrays forming holographic images.

Figures 1-4 show various exemplary embodiments, with diode bars 100 (Figures 2, 3, and 4), Holographic optical elements 120 and 125 (Figure 3), the holographic optical elements between slow/fast axis lenses (Figure 4) and multiple lenses that phase interact (vary the indices of refraction) to combine the original laser diode(s) profrile into a condensed image or spot size. Such a reduced spot size enables diodes to be useful for manufacturing processes.

The disclosure herein is intended to be explnatory in nature and not limitative to the scope of the present invention, where exemplary embodiments of the present invention are illustrated in Figures 1-4.